Discontinuous Galerkin time-stepping schemes for the parabolic p-Laplacian equation

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We consider fully-discrete schemes for the parabolic p-Laplacian equation. The schemes combine the discontinuous Galerkin time-stepping approach for the temporal discretization with classical conforming finite elements in space. In particular, we are interested in developing a symmetric -Céa Lemma type- error estimate for a suitable quasi-norm, under minimal regularity assumptions on the data. The above estimate leads to error bounds of arbitrary order in space and time provided that the necessary regularity is present, without imposing any restrictions between the temporal and spatial discretization parameters. The symmetric structure of the estimate also leads to various error estimates at partition points as well as for the natural energy $L^p(I;W^{1,p}(\Omega))$ norm. Furthermore, $L^\infty(I;L^2(\Omega))$ stability and error estimates are discussed. Finally, we present some possible extensions of our approach to the error analysis of suitable space-time discontinuous Galerkin schemes.

References:

[1] Error estimates for discontinuous Galerkin time-stepping schemes for the parabolic p-Laplacian: A quasi-norm approach, ESAIM, Math. Model. Numer. Anal, Vol. 59, No 1, 449-485, 2025.

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